The Yang of Things (YoT)

Andy Bierman

Michel Veillette

Peter van der Stok

Alexander Pelov <a@ackl.io>
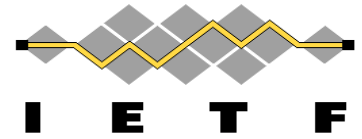
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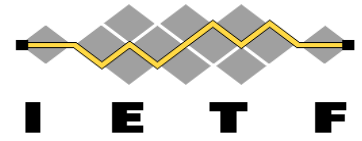
Why?

2003: IAB Network Management Workshop

Network Operators:

We want an easy to use and robust mechanism for provisioning devices and services across networks.

(+ a short list of **14** requirements)

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov

(from Carsten)

Interoperability

Semantic
Structural
Syntactic

Self-description
Introspection

Interaction Model

Semantic
Structural
Protocol Mapping

Extensible !

Pragmatic !

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Ecosystem

2003 – NETCONF WG
RFCs 4741, 4742, 4743, 4744

2008 – NETMOD WG
RFCs 6241, 6242, 6243, 6244,
6020, 6021

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Ecosystem
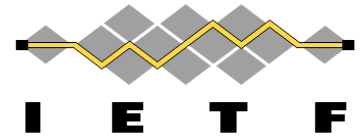
2003 – NETCONF WG
RFCs 4741, 4742, 4743, 4744

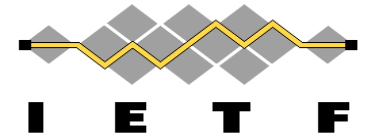**2008 – NETMOD WG**
RFCs 6241, 6242, 6243, 6244, 6020, 6021

TODAY

+1300 public YANG models

IETF WG
LIME, L3SM, SUPA, I2NSF

YANG Users
Broadband Forum – IEEE – IETF – ITU-T – Metro Ethernet Forum – OpenConfig – OpenDaylight – OpenNetworkingFoundation
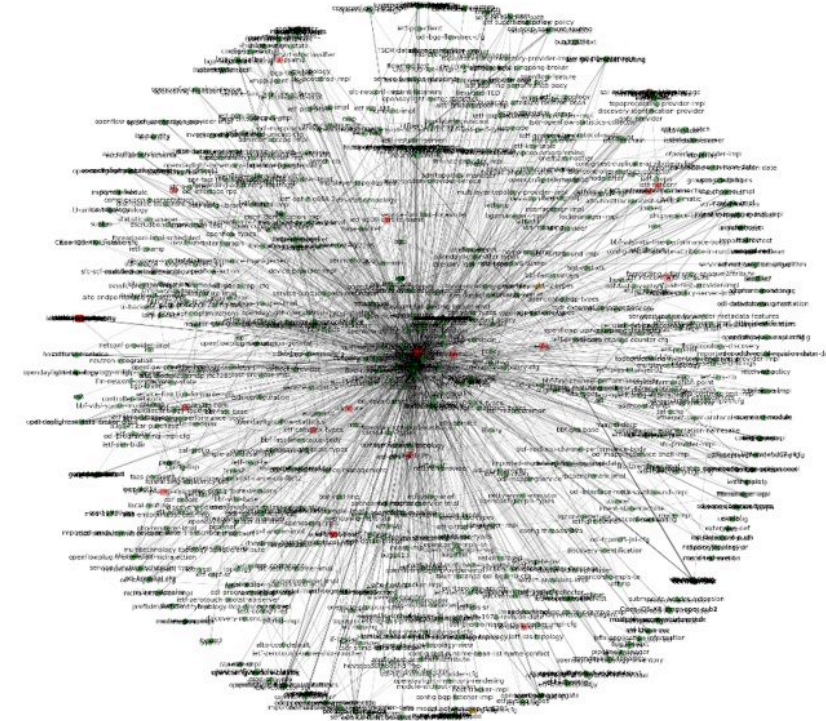
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It's the data model!

Powerful and versatile data modeling language

Standard data modeling language of choice at IETF for management.
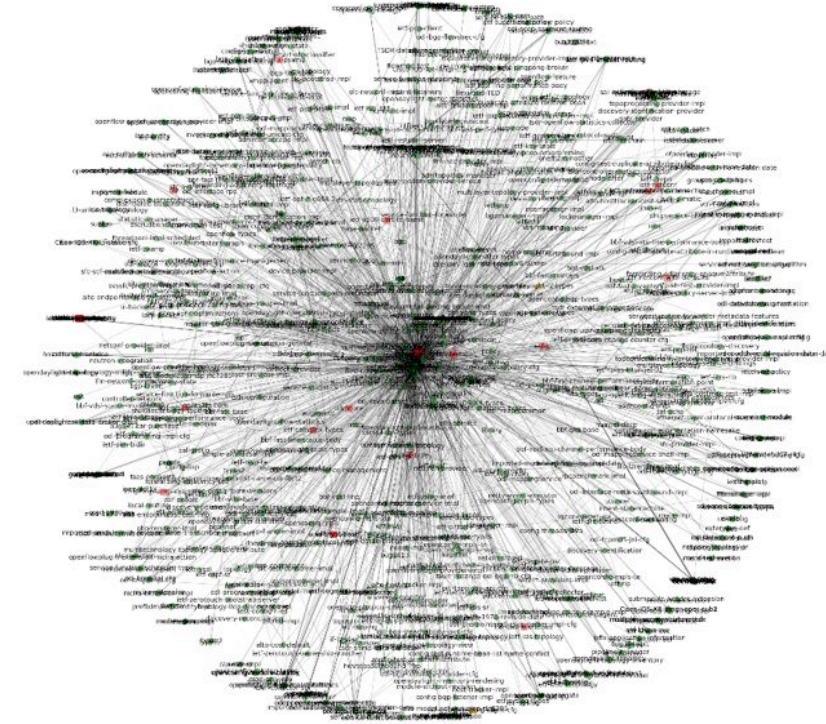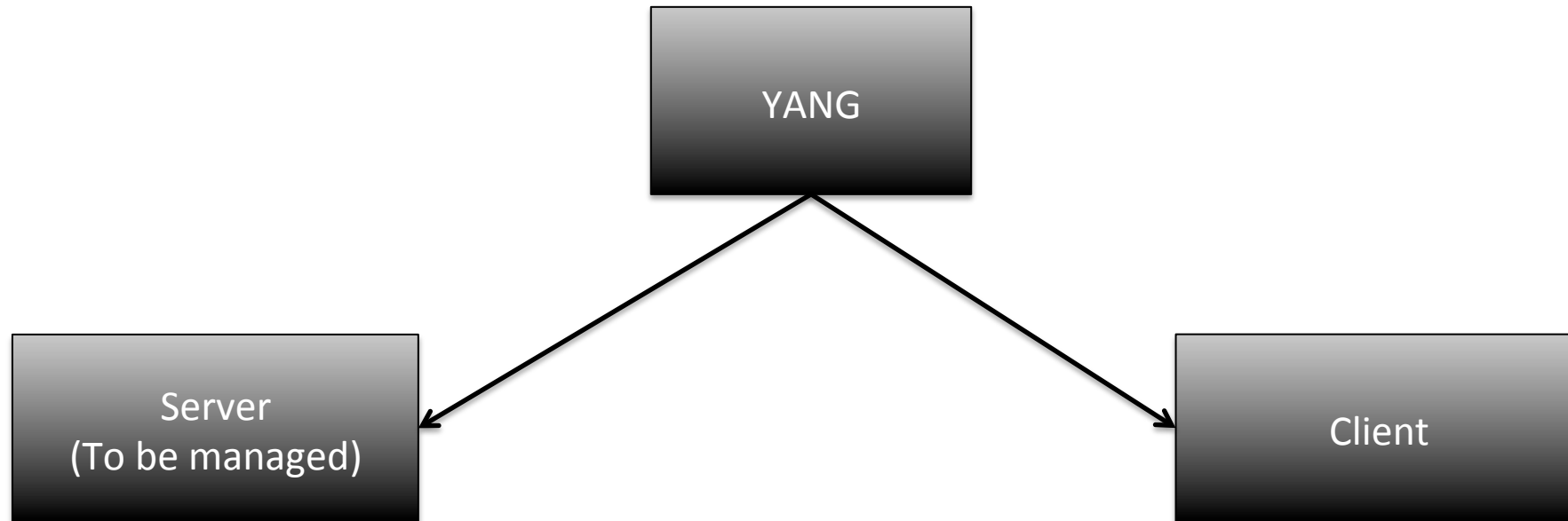
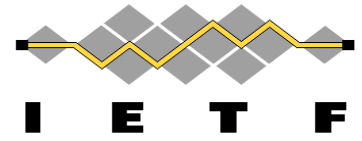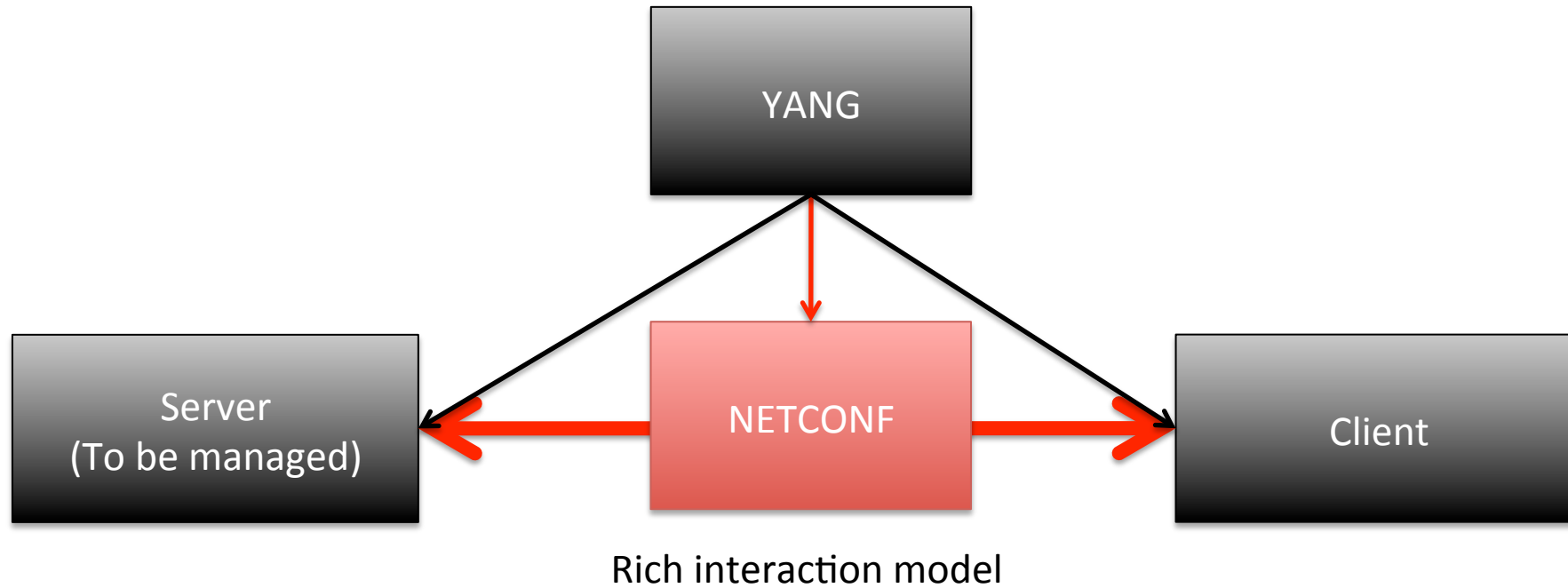YANG

All public YANG modules
April, 2017

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov

It's the data model!

IETF

Powerful and versatile data modeling language

Standard data modeling language of choice at IETF for management.

> YANG

Modules, sub-modules
Templates
Extending data models
Conditions (if-feature)
Extensible enumerations

Simple data types
    unsigned integer, integer, string,
    enumeration, bits, binary, empty
Unions
Labels (identity)
References to labels, data items, etc.
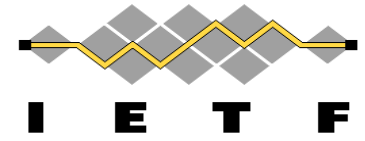Collections
    Sets, lists
Structures (composite types)

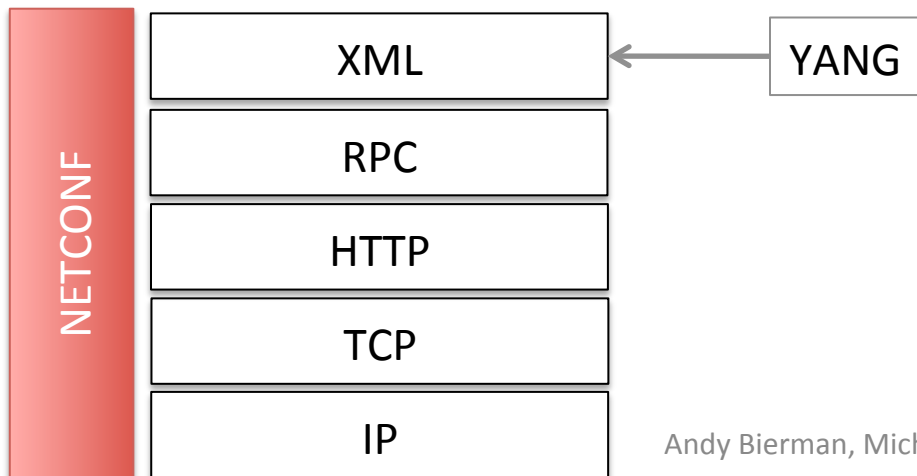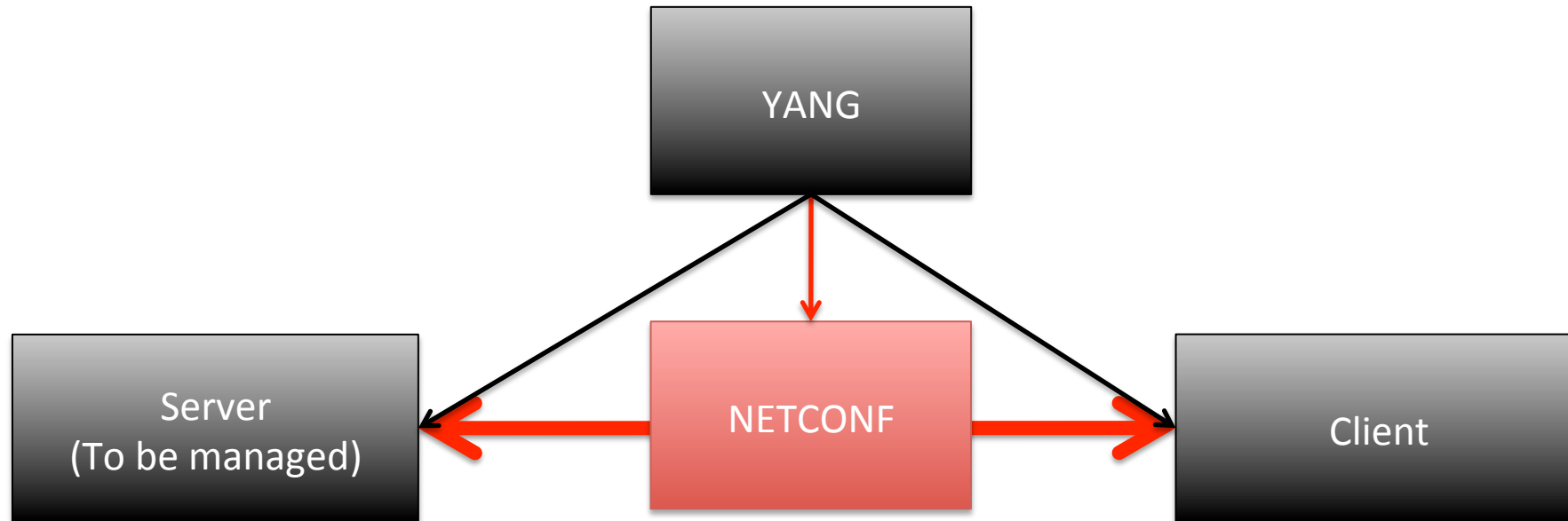All public YANG modules
April, 2017

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov
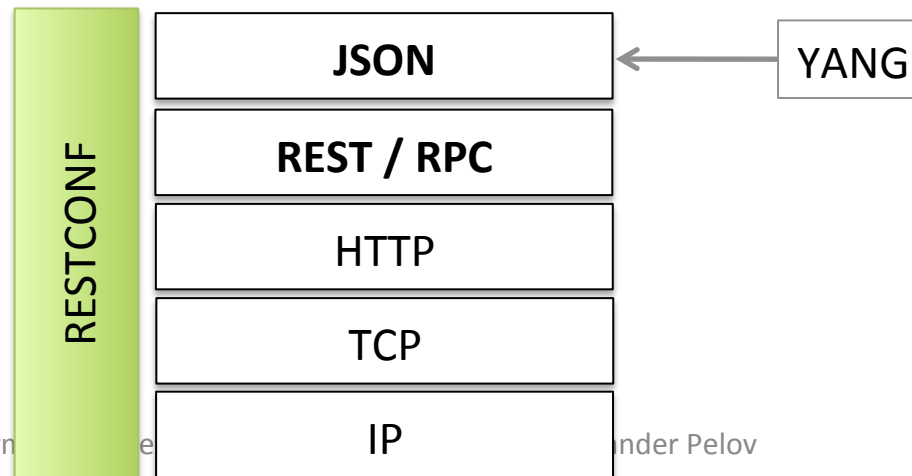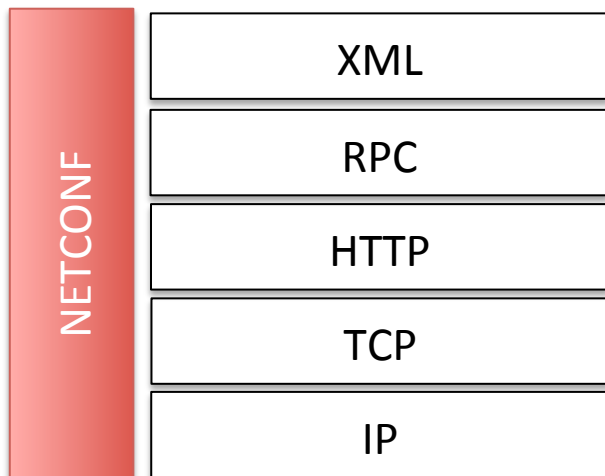
Data model as contract

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And the interaction model!

YANG

Server
(To be managed)

NETCONF

Client

Rich interaction model

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And the protocol bindings!

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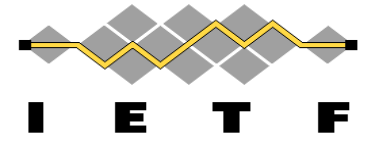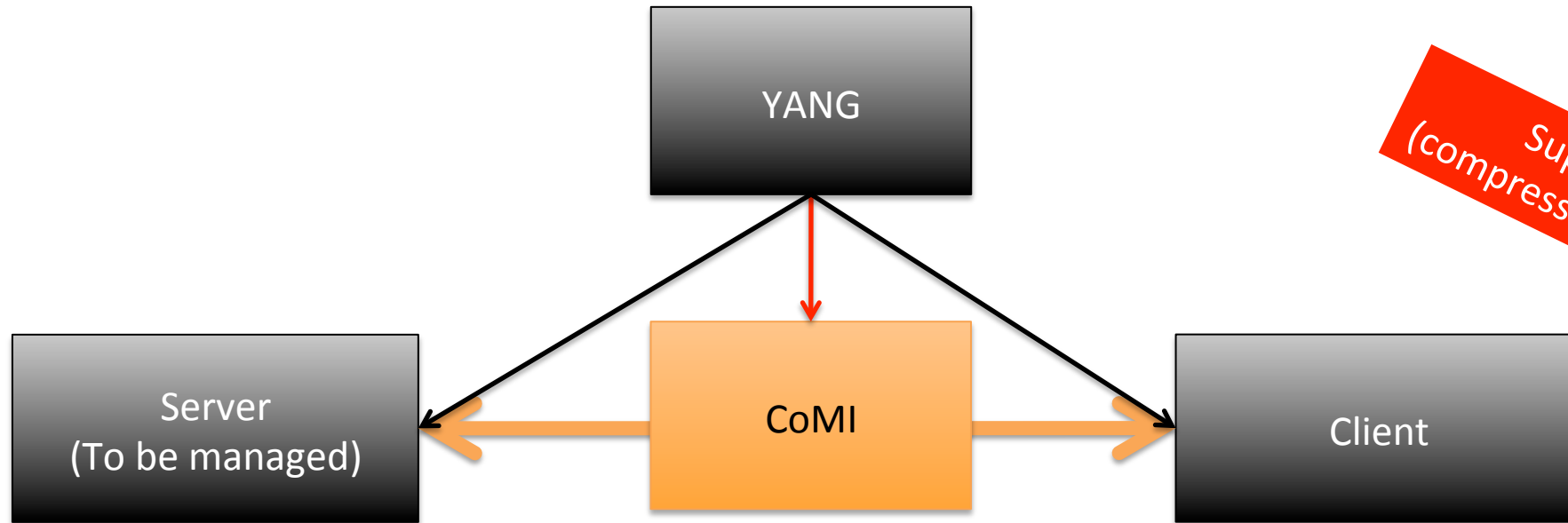
And the protocol bindings!

And the protocol bindings!

YANG

Server (To be managed) ← **CoMI** → **Client**
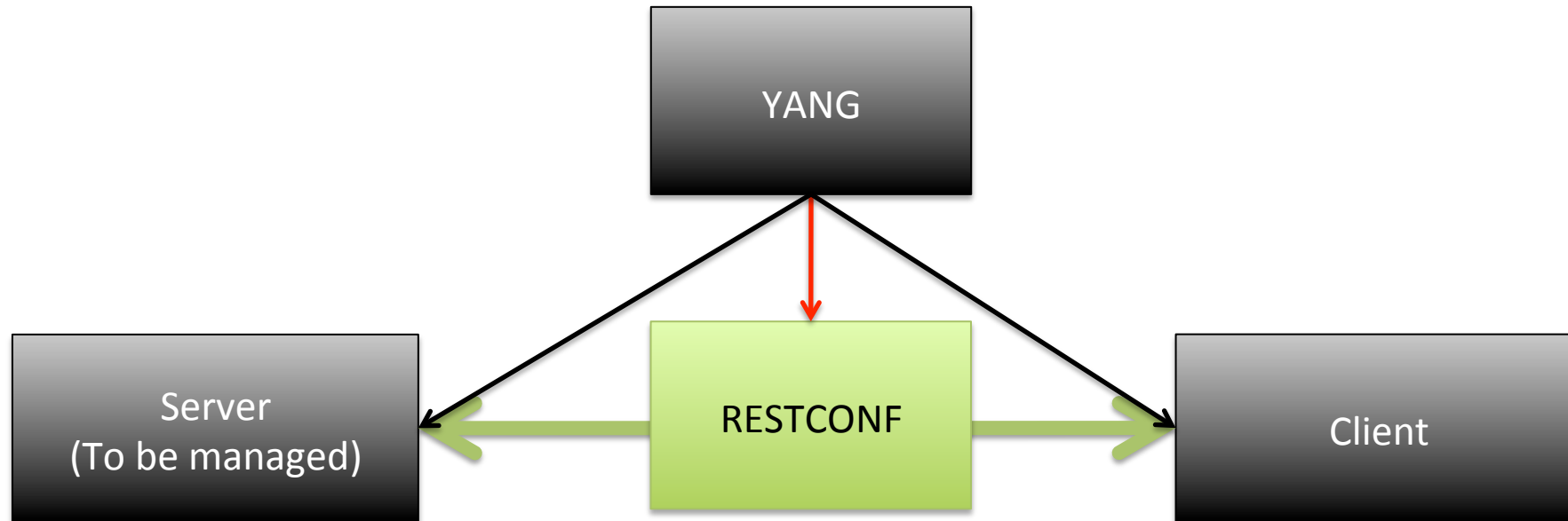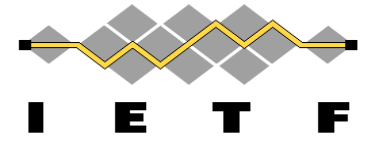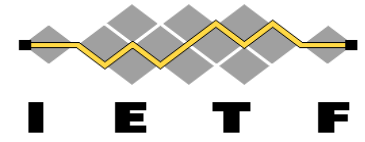
Super-efficient (compress even identifiers)
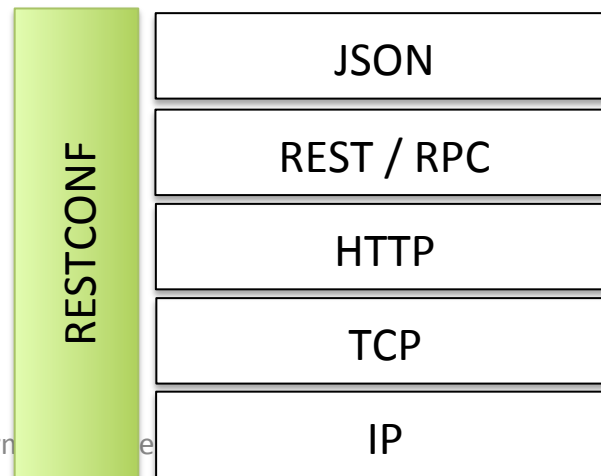
NETCONF		RESTCONF		CoMI	
	XML		JSON		**CBOR** ← YANG
	RPC		REST / RPC		REST / RPC
	HTTP		HTTP		**CoAP**
	TCP		TCP		**UDP**
	IP		IP		IP
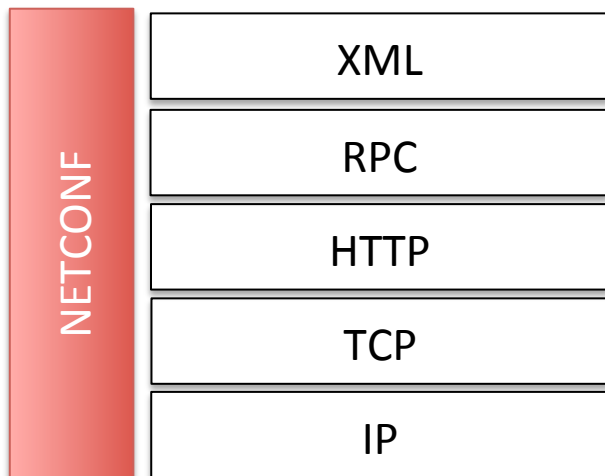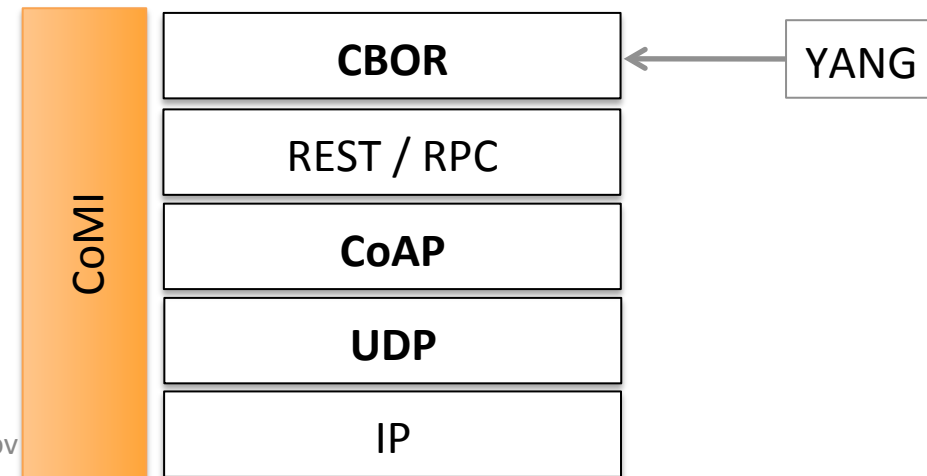
Which gives: the YANG Stack

YANG			Data Model
XML	JSON	**CBOR**	Data Representation
REST / RPC			Interaction Model
HTTP	CoAP		Protocol Bindings
TCP	UDP		
IP			

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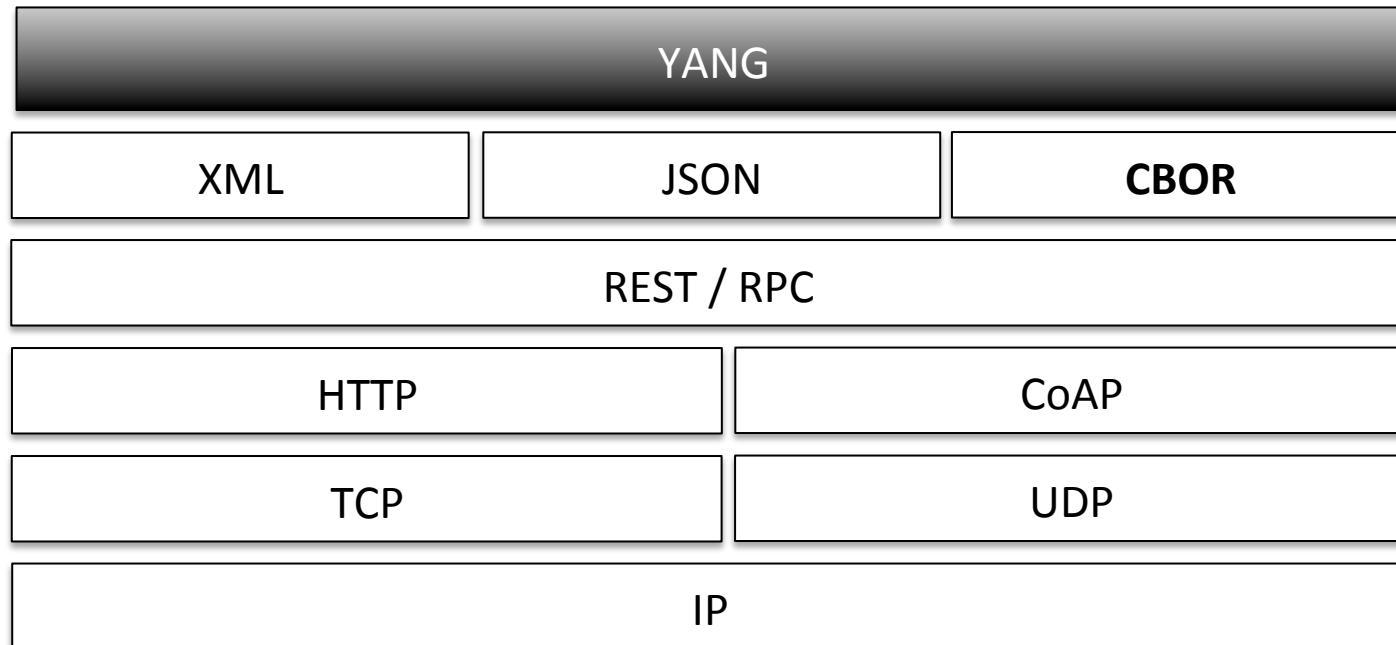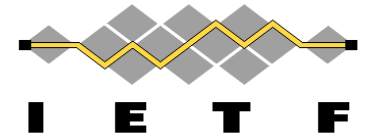
Features (small sample)

Constraints on data

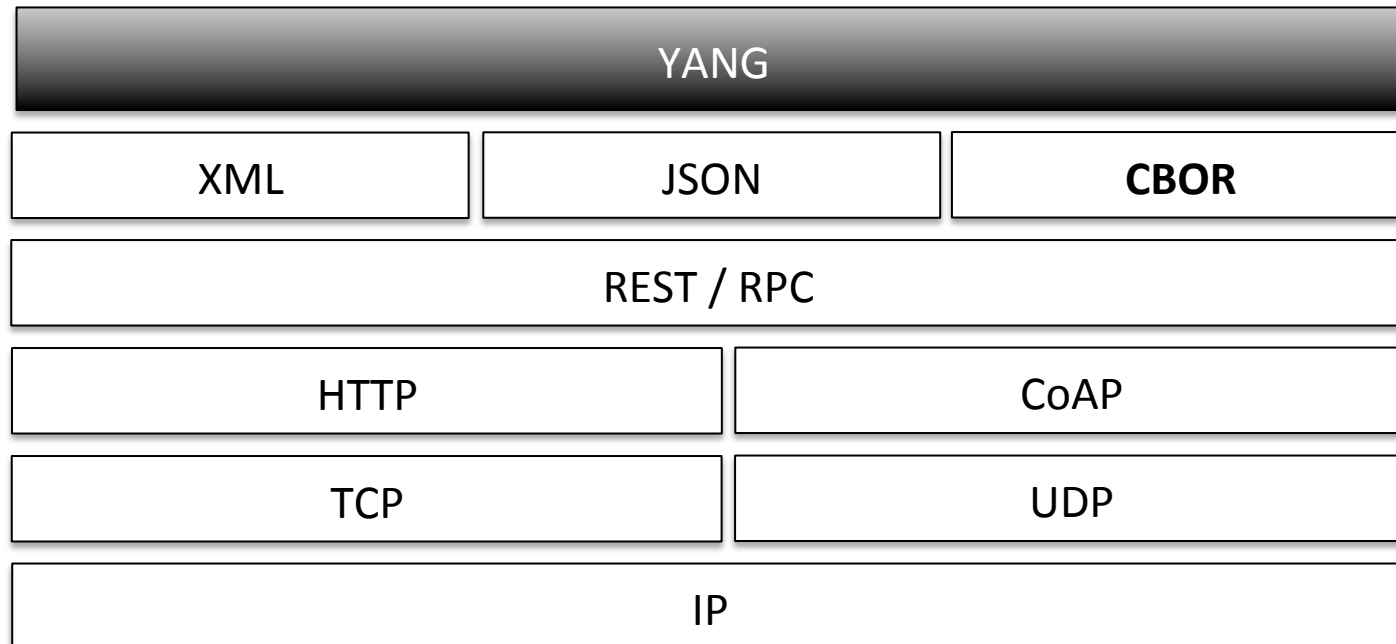Rich built-in data + Rich extension mechanism

Transactions

Balance between high-level data modeling and low-level bits-on-the-wire encoding

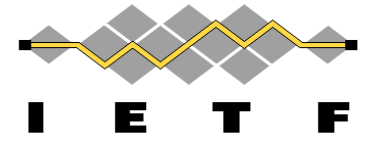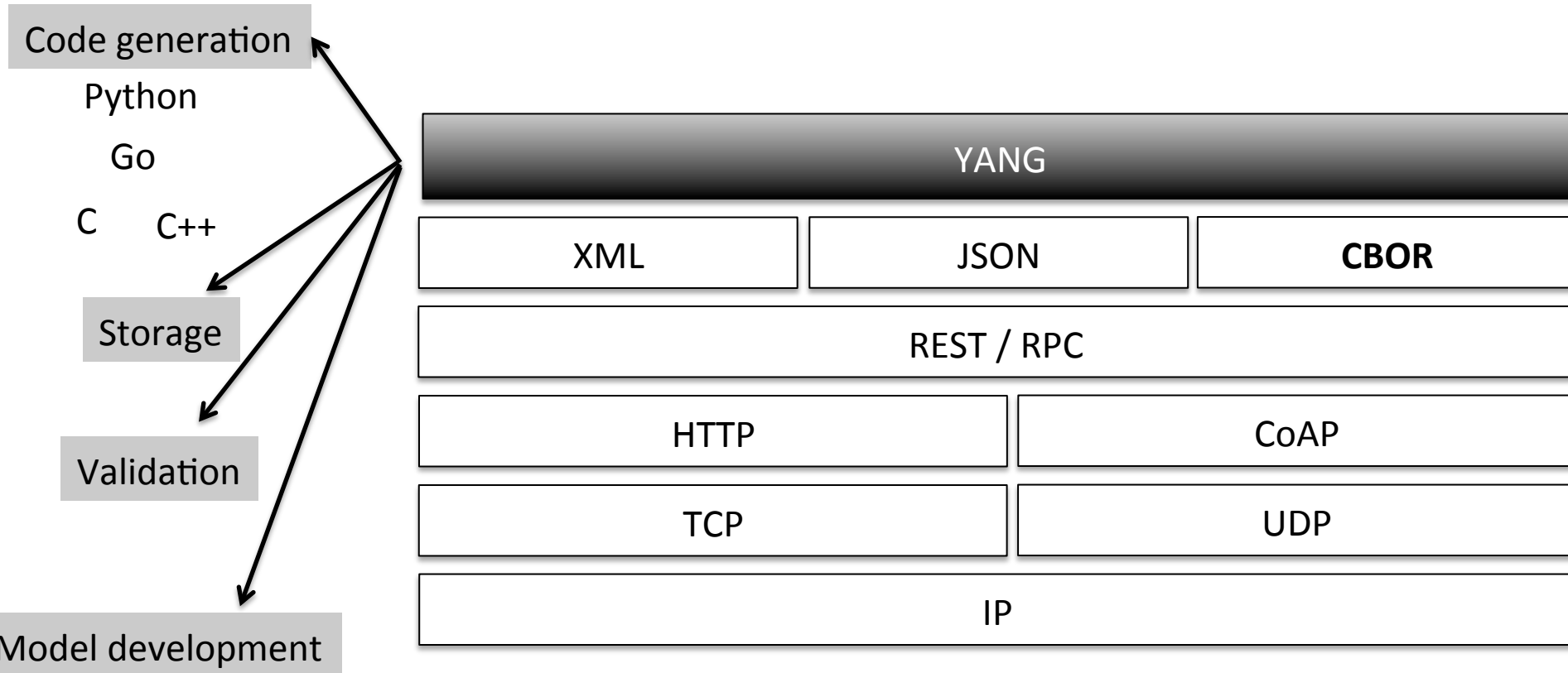| YANG			Data Model
XML	JSON	**CBOR**	Data Representation
REST / RPC			Interaction Model
HTTP	CoAP		Protocol Bindings
TCP	UDP		
IP			

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And the ecosystem

+ Tools!

Code generation

Python

Go

C   C++

Storage

Validation

Model development

| YANG | | | Data Model |

| XML | JSON | **CBOR** | Data Representation |

| REST / RPC | Interaction Model |

| HTTP | CoAP | Protocol Bindings |

| TCP | UDP | |

| IP | |

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A way into WoT

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov

YANG for IoT (YoT)

IETF
6TiSCH
LPWAN
(Side meetings)

YANG models
Manufacturer Usage
Description (MUD)
LWM2M – CoMI mapping
RD

Decentralized Registry
SID

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov
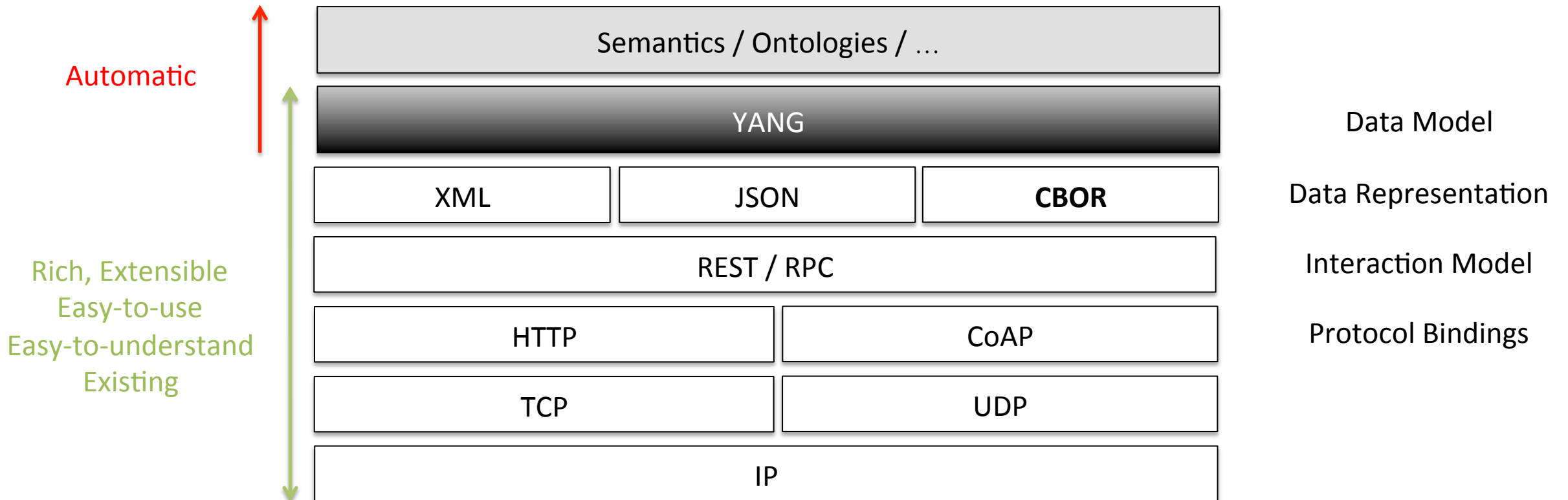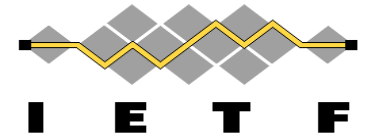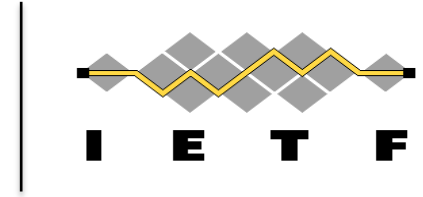
YANG for IoT (YoT)

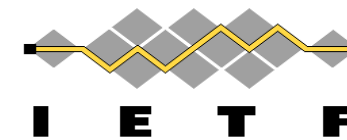**IETF**
6TiSCH
LPWAN
(Side meetings)

YANG models
Manufacturer Usage
Description (MUD)
LWM2M – CoMI mapping
RD

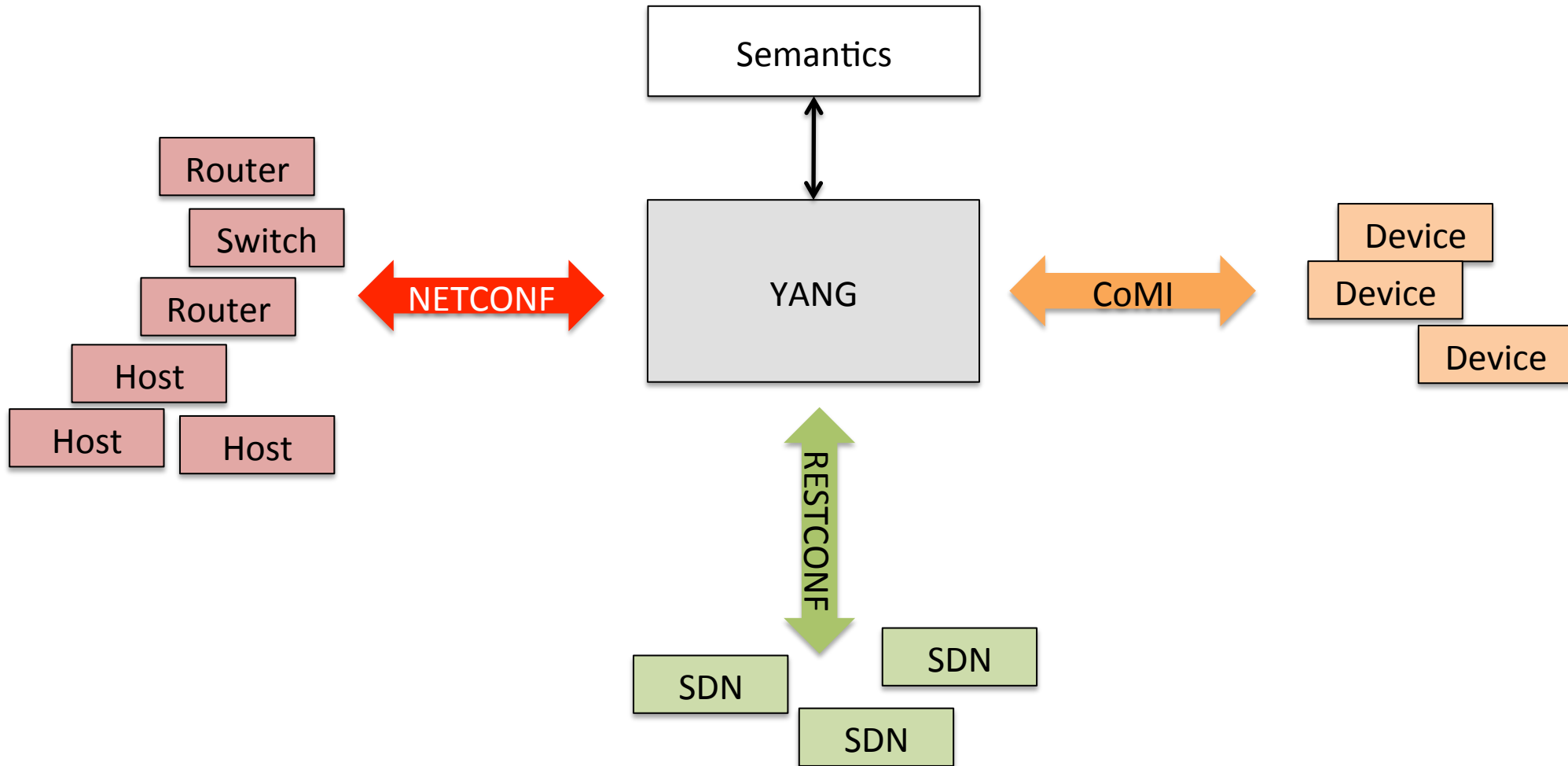**Decentralized Registry**
SID

Non-WG ML created: yot@ietf.org

Best practices for using YANG-based data modeling for the management of networks with constrained devices and constrained networks
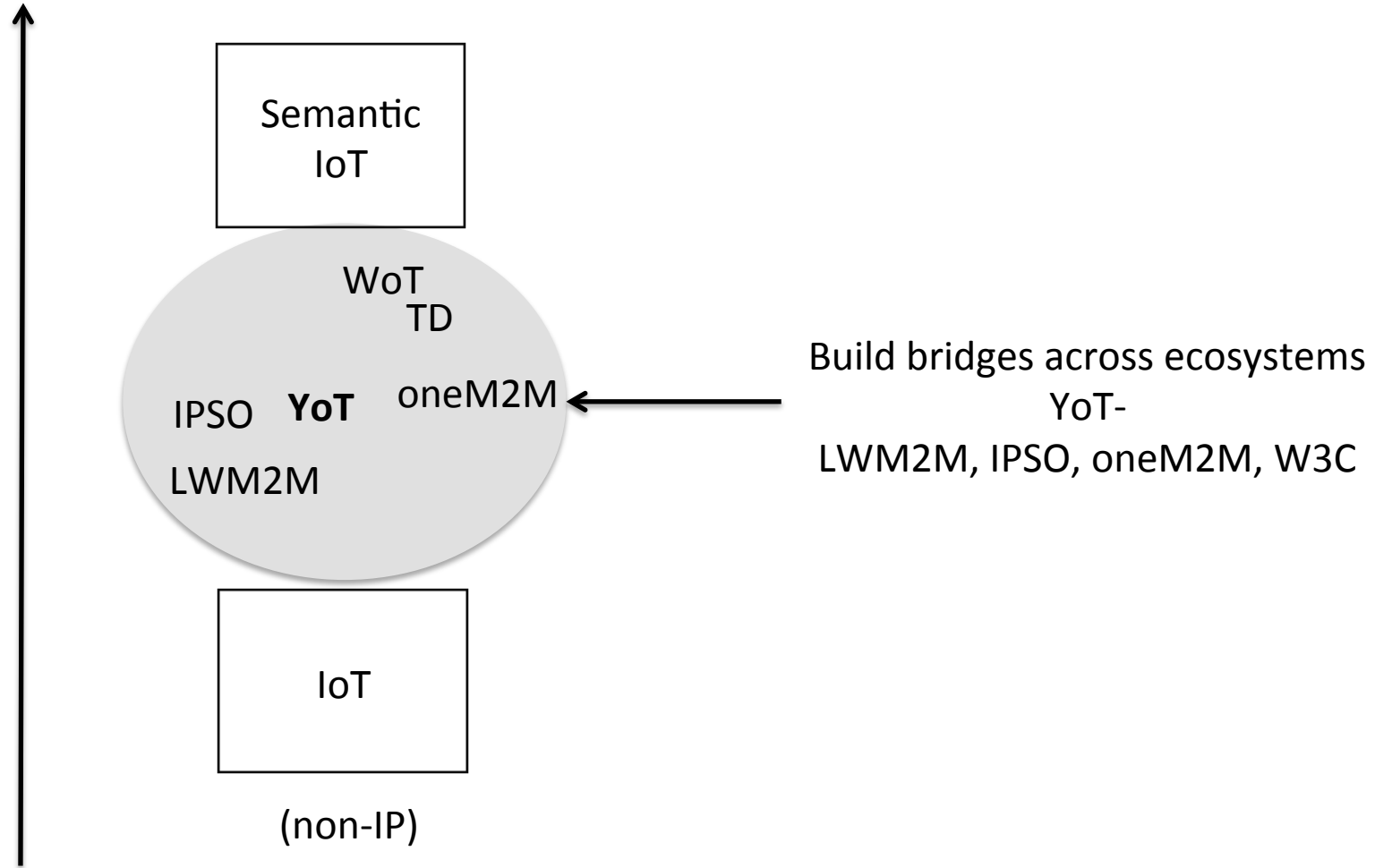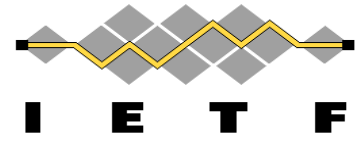
How to make use of properties of the combination of technologies involved (YANG, CBOR, SID, CoAP, RESTCONF, …)
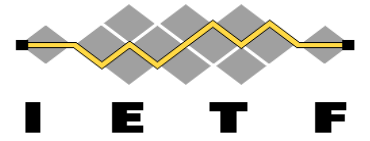
Side-meeting @ IETF: Thursday, 20

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A good, extensible building block

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov

The way ahead

Semantic IoT

WoT
TD

IPSO **YoT** oneM2M

LWM2M

Build bridges across ecosystems
YoT-
LWM2M, IPSO, oneM2M, W3C

IoT

(non-IP)

Andy Bierman, Michel Veillette, Peter van der Stok, Alexander Pelov

Thanks!

Andy Bierman
Michel Veillette
Peter van der Stok
Alexander Pelov <a@ackl.io>